APPLICATION OF RESULTS.

results sufficiently near the truth, by taking the middle of the joints, instead of the points A and D, as the points of application of the pressures.

It is very necessary to observe that the equation of equilibrium above determined is based upon such conditions, that the resultant of all the forces, both of the acting and resisting portions, passes through the point x at the back of the abutment. The dimensions thus determined will be sufficient only in the case of a rock, or other incompressible foundations; in other cases, where there is any liability to yield, the resultant, instead of passing through the extremity must pass through the middle of the base. This condition is, in general, best fulfilled by making the back of the abutment in steps or offsets, which permits an enlargement of the base, without greatly increasing the amount of masonry; and, at the same time, favors stability, by throwing the centre of gravity very much towards the face.

If the arch between D and B were in one solid piece without joints, it would follow, that the joints A B and C D, being entirely above and below the neutral axis, would be compressed throughout their whole extent, and would have no tendency to open; but cases have often occurred in which some of the joints have opened at the back or front, and the work suffered considerable derangement. Such an effect may result from two distinct causes.

First.—When an arch is constructed it is usual to commence by laying the stones nearest the abutment, and proceeding towards the centre; months sometimes elapse between the laying of the first and last stones of the arch, during which time, if the cement or mortar is of good quality, those first laid become solidly united to each other. If the centres are removed soon after the completion of the arch, and while some of the joints are in a soft or compressible state, inequalities of settling must result, sufficient in some cases of itself to account for all the observed derangement.

The second case, in which the joints of an arch will have a tendency to open, is when the line of pressure passes below the intrados, or above the extrados. To guard against this